

What is claimed is:

1. A solid-state image sensing apparatus that performs photoelectric conversion of incident light, comprising:

5 a photosensitive unit in which a plurality of photoelectric conversion circuits is laid out one-dimensionally or two-dimensionally, each of said photoelectric conversion circuits corresponding to a pixel and including a photodiode that accumulates electric charge by performing the photoelectric conversion of incident light and an output circuit that outputs the accumulated electric charge as an electric signal;

10 an electric charge simultaneous removal unit operable to simultaneously remove the accumulated electric charge in the photodiodes laid out in a predetermined region to be read out in the photosensitive unit; and

15 an electric charge accumulation unit operable to accumulate electric charge in the photodiode laid out in the region to be read out during a predetermined time after the accumulated electric charge in the photodiode that is laid out in the region is removed.

20 2. The solid-state image sensing apparatus according to Claim 1,

wherein the electric charge accumulation unit generates an electric accumulation start signal to start electric charge accumulation to the photodiode laid out in the region to be read out.

25 3. The solid-state image sensing apparatus according to Claim 2, wherein the electric charge accumulation unit generates an electric accumulation end signal and ends electric charge accumulation to the photodiode laid out in the region to be read out in response to activation of the electric charge accumulation end signal.

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4. The solid-state image sensing apparatus according to Claim 2, further comprising an incident light control unit operable to control incidence of light into the photosensitive unit,

5 wherein the electric charge accumulation unit ends electric charge accumulation to the photodiode laid out in the region to be read out using the incident light control unit by blocking out incidence of light into the photosensitive unit.

10 5. The solid-state image sensing apparatus according to Claim 1, further comprising an incident light control unit operable to control incidence of light into the photosensitive unit,

15 wherein the electric charge accumulation unit starts incidence of light to the photosensitive unit using the incident light control unit after the electric charge simultaneous removal unit simultaneously removes the accumulated electric charge to the photodiode laid out in the region to be read out.

6. The solid-state image sensing apparatus according to Claim 5,

20 wherein the electric charge accumulation unit generates an electric accumulation end signal and ends electric charge accumulation to the photodiode laid out in the region to be read out in response to activation of the electric charge accumulation end signal.

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7. The solid-state image sensing apparatus according to Claim 5,

30 wherein the electric charge accumulation unit ends electric charge accumulation to the photodiode laid out in the region to be read out using the incident light control unit by blocking out incidence of light into the photosensitive unit.

8. The solid-state image sensing apparatus according to Claim 5,
wherein the incident light control unit includes:

a liquid crystal shutter that is set up between the
photosensitive unit and an object to be photographed; and

5 a liquid crystal shutter control unit operable to apply a
predetermined voltage to the liquid crystal shutter to control
penetration of light.

9. The solid-state image sensing apparatus according to Claim
10 1,

wherein the electric charge simultaneous removal unit
simultaneously outputs a reset signal to all the photoelectric
conversion circuits laid out in the region to be read out; and

15 the output circuit in the photoelectric conversion circuit
includes:

a first transistor that receives the reset signal from the
electric charge simultaneous removal unit and that resets electric
charge accumulated in the photodiode in response to activation of
said reset signal; and

20 a second transistor that lets the electric signal pass through,
the electric signal according to value of voltage determined by
electric charge outputted from the photodiode.

10. The solid-state image sensing apparatus according to Claim 9,

25 wherein the electric charge simultaneous removal unit
generates a gate signal and includes a reset signal passage switch
that outputs simultaneously the reset signal to all the photoelectric
conversion circuits in response to activation of the gate signal.

30 11. The solid-state image sensing apparatus according to Claim 9,
wherein the electric charge simultaneous removal unit
includes:

a switch transistor that serves as a switch; and
a capacitor that is set up between a gate and a source or a drain of the switch transistor, and

when the capacitor is charged, the reset signal is inputted
5 from the drain of the switch transistor and is outputted simultaneously to all the photoelectric conversion circuits from the source.

12. The solid-state image sensing apparatus according to Claim 1,
10 wherein the electric charge simultaneous removal unit outputs a readout signal simultaneously and outputs a reset signal to all the photoelectric conversion circuits laid out in the region to be read out, and

the output circuit in the photoelectric conversion circuit
15 includes:

a first transistor that receives the readout signal from the electric charge simultaneous removal unit and lets the electric charge accumulated in the photodiode pass through in response to activation of the readout signal; and

20 an electric charge retention unit operable to receive the electric charge that passes through the first transistor and retain said electric charge;

a second transistor that lets the electric signal pass through, the electric signal according to value of voltage determined by the
25 electric charge retained by the electric charge retention unit; and

a reset circuit that receives the reset signal from the electric charge simultaneous removal unit and that resets an amount of electric charge accumulated in the electric charge retention unit in response to activation of the reset signal.

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13. The solid-state image sensing apparatus according to Claim 12, further comprising an electric signal readout unit operable to

read out the electric signal outputted from the photoelectric conversion circuit laid out in the region to be read out,

wherein the electric signal readout unit includes:

a first unit operable to output the activated reset signal to the reset circuit in the photoelectric conversion circuit laid out in the region to be read out; and

a second unit operable to output the activated readout signal to said reset circuit after outputting said reset signal, and

the first unit outputs the reset signal activated after the predetermined time in the electric charge accumulation unit has passed.

14. The solid-state image sensing apparatus according to Claim 13,

wherein the electric signal readout unit reads out simultaneously accumulated electric charge of the photodiode laid out in the region to be read out.

15. The solid-state image sensing apparatus according to Claim 13, further comprising a frame memory that can store simultaneously all the electric signals outputted from the photoelectric conversion circuit laid out in the region to be read out,

wherein the electric signal readout unit transmits simultaneously to the frame memory the electric signals outputted from the photoelectric conversion circuit laid out in the region to be read out.

16. The solid-state image sensing apparatus according to Claim 13, further comprising the frame memory that can store simultaneously all the electric signals outputted from the photoelectric conversion circuit laid out in the region to be read out,

wherein the electric signal readout unit writes to the frame

memory in sequence the electric signals outputted from the photoelectric conversion circuit laid out in the region to be read out within a short period of time which can be negligible compared with the predetermined time in the electric charge accumulation unit.

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17. The solid-state image sensing apparatus according to Claim 12, further comprising an electric signal readout unit operable to read out the electric signal outputted from the photoelectric conversion circuit laid out in the region to be read out,

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wherein the electric signal readout unit includes:

a first unit operable to output the activated reset signal to the reset circuit in the photoelectric conversion circuit laid out in the region to be read out; and

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a second unit operable to output the activated readout signal to said reset circuit after outputting said reset signal, and

the first unit outputs the reset signal activated before the predetermined time in the electric charge accumulation unit has passed.

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18. The solid-state image sensing apparatus according to Claim 17,

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wherein the first unit outputs the activated reset signal in overlapping time of a period before the predetermined time in the electric charge accumulation unit has passed and a period during which the electric charge simultaneous removal unit outputs the activated reset signal.

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19. The solid-state image sensing apparatus according to Claim 12, further comprising an electric signal readout unit operable to read out the electric signal outputted from the photoelectric conversion circuit laid out in the region to be read out,

wherein the electric signal readout unit includes:

a first unit operable to output the activated reset signal to the reset circuit in the photoelectric conversion circuit laid out in the region to be read out; and

a second unit operable to output the activated readout signal to said reset circuit after outputting said reset signal, and

the first unit outputs the activated reset signal for a period since some mid point of the predetermined time until an end of said predetermined time in the electric charge accumulation unit.

20. The solid-state image sensing apparatus according to Claim 12,

wherein the electric charge simultaneous removal unit generates a gate signal and includes a readout signal passage switch that outputs simultaneously the readout signal to all the photoelectric conversion circuits in response to the gate signal.

21. The solid-state image sensing apparatus according to Claim 12,

wherein the electric charge simultaneous removal unit includes:

a switch transistor that serves as a switch; and

a capacitor that is set up between a gate and a source or a drain of the switch transistor, and

when the capacitor is charged, the reset signal is inputted from the drain of the switch transistor and is outputted simultaneously to all the photoelectric conversion circuits from the source.

22. A camera that photographs an object comprising

a solid-state image sensing apparatus; and

a mechanical shutter,

wherein the solid-state image sensing apparatus includes:

a photosensitive unit in which a plurality of photoelectric conversion circuits is laid out one-dimensionally or two-dimensionally, each of said photoelectric conversion circuits corresponding to a pixel and including a photodiode that
5 accumulates electric charge by performing the photoelectric conversion of incident light and an output circuit that outputs the accumulated electric charge as an electric signal;

an electric charge simultaneous removal unit operable to simultaneously remove the accumulated electric charge in the
10 photodiode laid out in a predetermined region to be read out in the photosensitive unit;

an electric charge accumulation unit operable to accumulate electric charge in the photodiode laid out in the region to be read out during a predetermined time after accumulated electric charge in
15 the photodiode that is laid out in the region is removed; and

an incident light control unit operable to control incidence of light into the photosensitive unit,

wherein the mechanical shutter is set up between the photosensitive unit of the solid-state image sensing apparatus and
20 an object to be photographed,

the electric charge accumulation unit ends electric charge accumulation to the photodiode laid out in the region to be read out using the incident light control unit by blocking out incidence of light into the photosensitive unit, and

25 the incident light control unit controls incidence of light into the photosensitive unit by controlling opening and shutting of the mechanical shutter.

23. An image sensing method for photographing an object using a
30 solid-state sensing apparatus,

wherein the solid-state image sensing apparatus includes a photosensitive unit in which a plurality of photoelectric conversion

circuits is laid out one-dimensionally or two-dimensionally, each of said photoelectric conversion circuits corresponding to a pixel and including a photodiode that accumulates electric charge by performing the photoelectric conversion of incident light and an
5 output circuit that outputs the accumulated electric charge as an electric signal, and

the image sensing method comprising the steps of:

simultaneously removing the accumulated electric charge in the photodiode laid out in a predetermined region to be read out in
10 the photosensitive unit; and

accumulating electric charge in the photodiode laid out in the region to be read out during a predetermined time after the accumulated electric charge of the photodiode that is laid out in the region is removed.